63-2-5

[redacted]

DEFENSE RESEARCH LABORATORY

THE UNIVERSITY OF TEXAS · AUSTIN 12, TEXAS

PROGRESS REPORT NO. 1

ON

CONTRACT NObs-88181

1 OCTOBER - 31 DECEMBER 1962

31 December 1962 Copy No. 11

Sponsor: Department of the Navy, Bureau of Ships
Applied Research Division Ship Silencing Branch

Project S-F-013-11-01, Task 1359

DEFENSE RESEARCH LABORATORY
THE UNIVERSITY OF TEXAS
AUSTIN 12, TEXAS

ABSTRACT

It is estimated that printing and binding work on the acoustic filter design manual, prepared under Contract NObs-86165, will be completed in February, 1963. Impedance computer design work is discussed. The computer block diagram has been revised; a nonlinear mechanical unit to drive the beat frequency audio oscillator has been designed; so have some of the required circuits. Two commercial logarithmic voltage compressor units for the computer have been purchased. In a test of one of the units, it was found that the output voltage differed from that claimed by the manufacturer by at most 0.02 V peak over the input signal range 0.1 to 100 V peak. Filter calculations with measured admittances have been summarized. On the basis of an assumption of losslessness of the filter and power considerations, an expression for sound pressure at the filter output for unit source pressure is found. The expression is in terms of the ratio of the magnitudes of filter output and input pressures and the pressure at the filter input for a unit source pressure. Both the magnitude ratio and the input pressure depend on the filter input admittance which is calculated from measured characteristics of the filter, such as side-branch element admittance, and from acoustic transmission line characteristics.

Results of measurement of branch admittance of a spring-piston type filter element are compared with values predicted by calculation using lumped element acoustical parameters of the element. The curve plotted from measured values shows resonance peaks at 45 cps and 55 cps, whereas the calculations predict a single peak at 53 cps. The curves from measured and calculated values are of the same general shape, but the measured admittances are higher than those calculated for frequencies off resonance. Three different means of obtaining matched, resistive terminations for water columns have been considered. These are (1) use of magnetic damping effects, (2) use of damping characteristics of films of viscous materials, and (3) use of the resistance of liquid flow in tubes. The first two methods are not attractive because the field strength of available magnetic equipment is not large enough for minimum obtainable coil resistances and because difficulties in maintaining uniform viscous film characteristics are forseen. A device using parallel resistance tubes has been designed; it is intended for use with 30,000 centistoke Dow Corning silicone fluid to produce a resistance of $3160 \frac{\text{gm}}{\text{sec cm}^4}$.

TABLE OF CONTENTS

31 December 1962
JVK:lm

PROGRESS REPORT NO. 1
ON
CONTRACT NObs-88181

I. ADMINISTRATION

A. Introduction

This report covers technical work performed under Contract NObs-88101, during the months of October, November, and December, 1962. This contract, a successor to Contract NObs-86165, became effective 1 October 1962; it continues through 30 September 1963.

Technical work under this new contract comprises (1) a study of pipe fittings by impedance methods, (2) impedance measurements to improve prediction of filter performance, and (3) design and construction of equipment to automatically compute acoustic impedance or admittance from impedance head transducer signals.

Milestone versus Forecasted Achievement Date and Cumulative Cost Plan, Contract NObs-88181, Project S-F-013-11-01, Task 1359 was submitted 27 November 1962.

J. V. Kahlbau attended the 31st Symposium on Shock, Vibration, and Associated Environments in Phoenix, Arizona, on 4, 5, and 6 October 1962. Dr. E. L. Hixson and Mr. F. O. Bohls presented a paper entitled "Prediction of Pipe Vibration Isolator Effectiveness by Mobility Parameter Methods" at the 64th Meeting of the Acoustical Society of America held 7, 8, 9, and 10 November 1962, in Seattle, Washington.

31 December 1962
JVK:lm

B. Research Staff

Name	Degree	Position	Time
Bohls, F. O.*	M.A.	Research Physicist	1.00
Cousins, E. L.	B.S.	Research Engineer	1.00
Galloway, D. G.	B.S.	Research Engineer	0.50
Hixson, E. L.	Ph.D.	Research Engineer	0.50
Kahlbau, J. V.	M.A.	Supervisor, Noise and Vibration Section	1.00
McKinney, C. M.	Ph.D.	Head, Acoustics Division	0.05

*Transferred 1 December 1962.

31 December 1962
JVK:lm

II. SUMMARY OF TECHNICAL WORK

A. Acoustic Filter Design Manual

The manual, Guide to the Selection of Acoustic Filters for Liquid-Filled Systems, written under Contract NObs-86165 is almost ready to be printed in quantity. Drafting work is completed, and multilith mats of the text are being typed. Graph paper for production of the manual is on hand and multilith paper is on order.

It is expected that production of this report will be completed in February, 1963.

Eight hundred copies of the report will be printed. Approximately one hundred of these will be used to fill the list for initial distribution specified by the Bureau of Ships; the remaining copies will be retained by Defense Research Laboratory for subsequent distribution as may be directed by the Bureau.

31 December 1962
JVK:lm

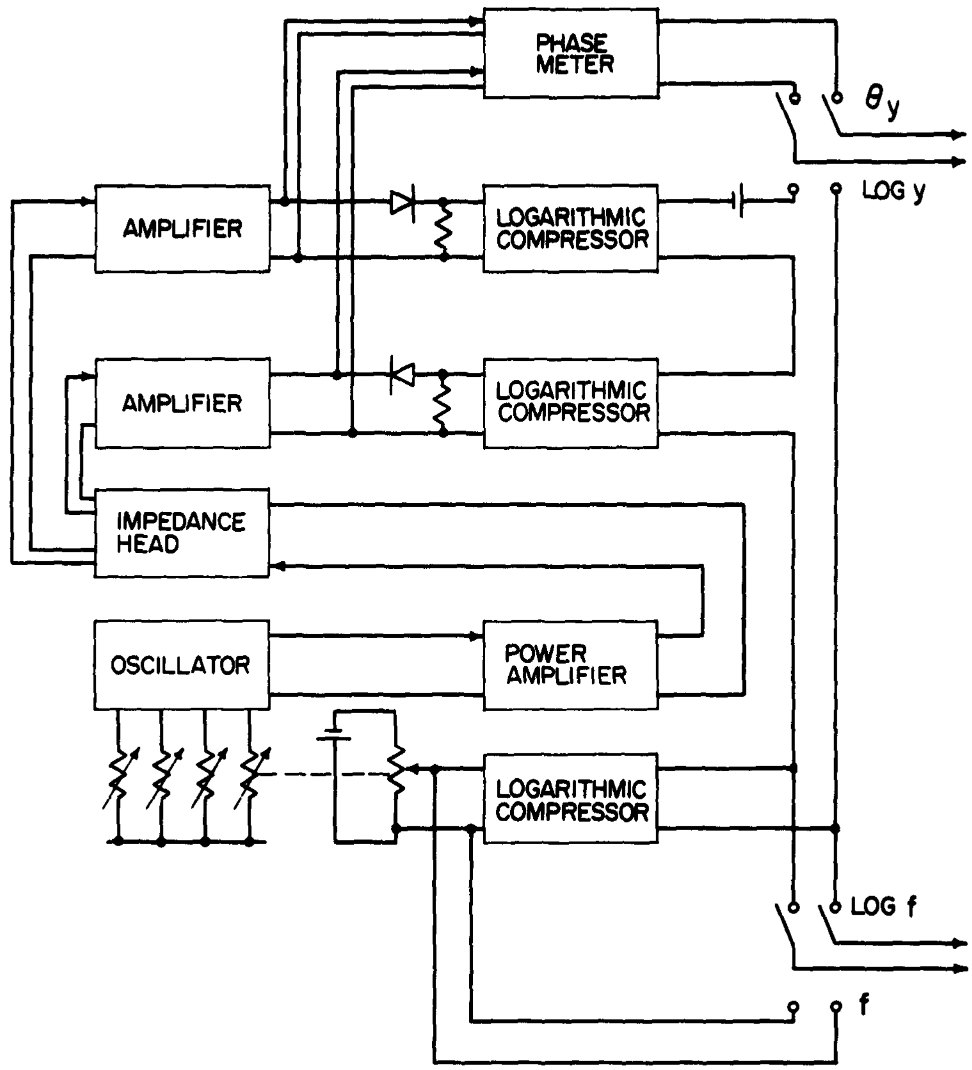
B. Impedance Computer

1. Block Diagram

Further considerations of the impedance computer circuit problems have suggested several changes in the arrangement of basic elements. Drawing AS-7604 shows a block diagram of the computer as it was originally proposed, and Dwg. AS-7605 shows it as it is presently conceived. As presently foreseen, the computer will function as follows: a motor-controlled, beat frequency, audio oscillator will provide a sinusoidal voltage which will be amplified and used as the input to the magnetic shaker portion of the acoustic impedance head. Signals from pressure and acceleration transducers in the impedance head supply two identical information channels where each signal is amplified, passed through a simple compensation network, amplified again, logarithmically converted, amplified a third time and finally converted to dc. An adder circuit combines the dc signals from these two channels with a constant battery voltage and a voltage proportional to the logarithm of the oscillator frequency. This resultant voltage will be proportional to either impedance or admittance depending on how the various voltages are combined in the adder. Relative phase of the ac voltages is measured after the final amplification. This point is selected on the basis of the phase meter input signal level requirements. The y-axis input of the x-y plotter is supplied by either the output of the phase meter or the output voltage from the adder. A constant B+ voltage appearing at the phase meter output terminals is eliminated by a separate circuit. The x-axis input of the plotter is supplied by a dc voltage proportional to the logarithm of the oscillator frequency. This voltage is supplied by a linear potentiometer driven by the motor which turns the oscillator frequency shaft. The oscillator shaft position is logarithmically related to frequency so the required voltage is easily obtained.

2. Commercial Equipment to be Used in Computer

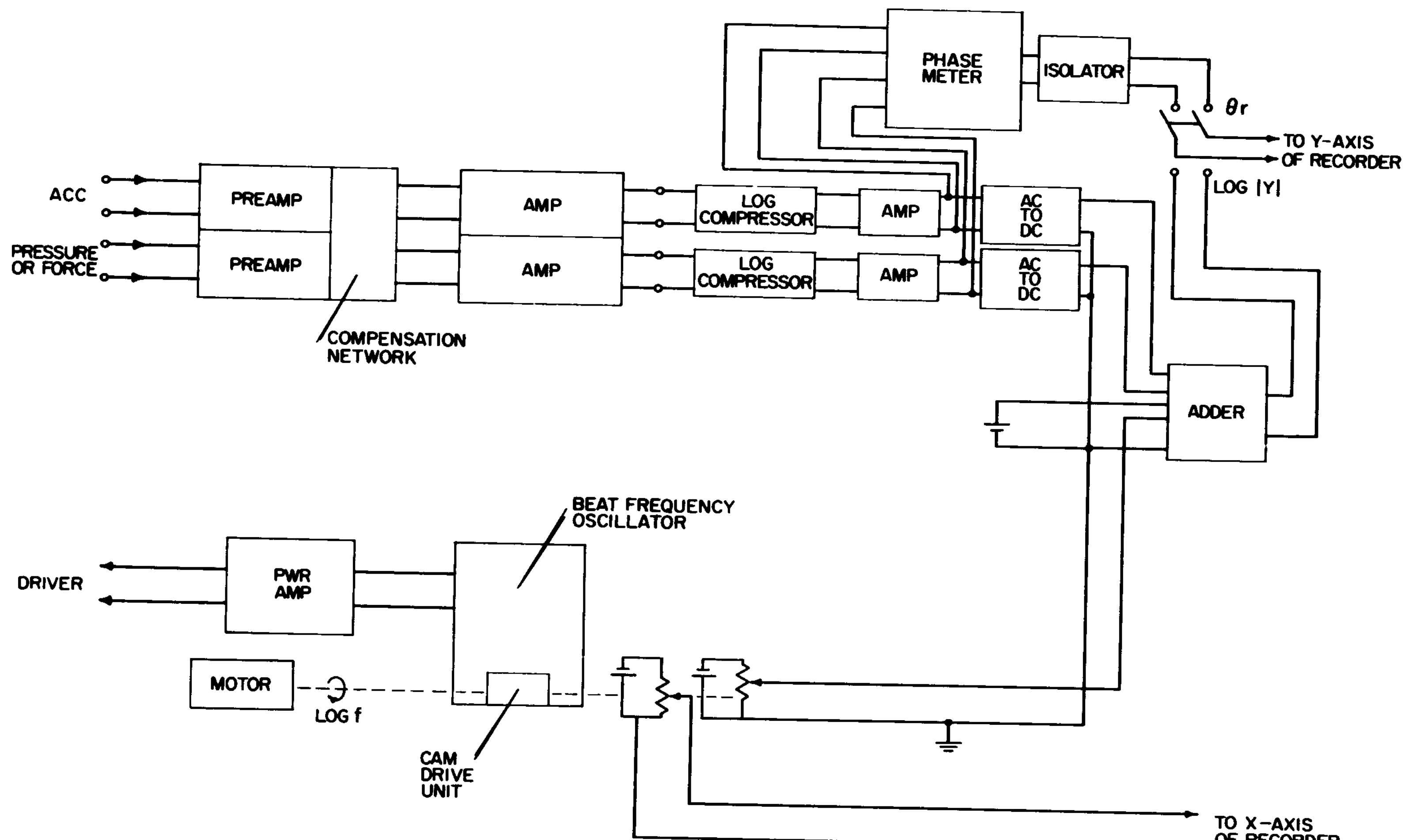
Some of the functions indicated in the block diagram, Dwg. AS-7605, will be performed by pieces of commercial equipment. These pieces of equipment



$$\mathrm{LOG}\ |Y| = \mathrm{LOG}\ |E_a| - \mathrm{LOG}\ |E_p| - \mathrm{LOG}\ f + \mathrm{LOG}\ K$$

ORIGINAL BLOCK DIAGRAM
ADMITTANCE-IMPEDANCE COMPUTER

DRL-UT
DWG AS 7604
JVK-PRS
2-6-63



BLOCK DIAGRAM
ACOUSTIC IMPEDANCE-ADMITTANCE COMPUTER

DRL – UT
DWG AS 7605
JVK – PRS
2 – 13 – 63

are listed below with their manufacturers' model and serial numbers, and a few rudimentary specifications.

(1) Phase Meter
Manufacturer: Ad-Yu Electronics Laboratories
Type: 405
Serial No.: 1732
Specifications:
Frequency Range 8 cps - 40 kc
Phase Ranges 0-12, 0-36, 0-90, 0-180
Relative Accuracy ±0.25°
Absolute Accuracy ±1°
Input Impedance: 3 MΩ, shunted by 20μμf
Output Impedance: 360 k
Output Voltage: (-14) - (0) volts with respect to B+

(2) x-y Plotter (available on loan basis)
Manufacturer: Houston Instrument Corporation
Model No.: HR-93-1
Serial No.: 617
Specifications:
Input Resistance: 10,000 Ω across variable attenuator
Pen Speed: 7.5 in. per sec max
Accuracy: ±0.5% static
±0.5% dynamic at constant velocity to 7.0 in. per sec
Sensitivity: 10mv/in.
Chart Size: 8-1/2 x 11 in.

(3) Power Amplifier
Manufacturer: McIntosh Laboratory, Inc.
Model No.: MC 75
Serial No.: 106136

Specifications:

Power Output: 75 W continuous

Frequency Range: 16 cps - 40 kc, +0, -0.1 dB at 75 W

Output Impedances: 4, 8, 16, 62, 150, and 600 Ω

Input Impedance: 250,000 Ω

(4) Beat Frequency Oscillator

Manufacturer: Brüel and Kjaer

Type No.: BL1011

Serial No.: 2981

Specifications:

Frequency Range: 0 - 20,000 cps

Frequency Scale: Linear from 0 to 100 cps,
Logarithmic 100 cps to 20 kc

Frequency Accuracy: 1% ± 1 cps

Output Impedance: 6, 60, 600, 6000 Ω

Max Output Power: 3 W

(5) Logarithmic Voltage Compressors

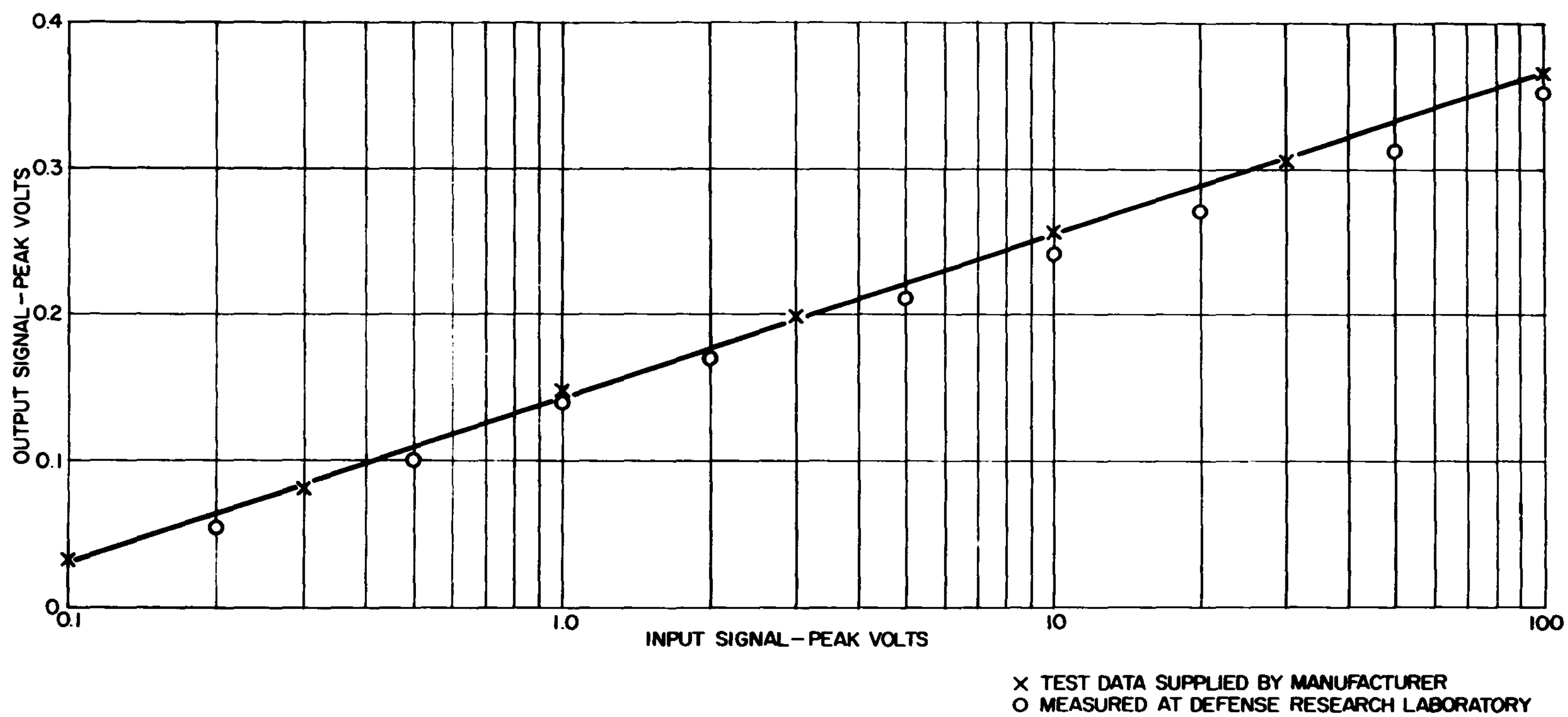
Manufacturer: Kane Engineering Laboratories

Model No.: C-7A

Serial Numbers: 182 and 183

Description: The manufacturer's instruction sheet gives the following description of these units. "The Logarithmic Voltage Compressor, Model C-7A, is a nonlinear voltage divider circuit to produce an output voltage proportional to the logarithm of the input voltage. The linear dynamic range is 60 dB, extending from 0.1 V to 100 V input. When operating into a typical oscilloscope input of 1 MΩ shunted by 30 pf, the response is flat from d-c to 200 kc and drops at most 10 percent at 500 kc. Operation to 1 mc is possible when using lower capacitive loading."

Two of these units have been bought and tested. Drawing AS-7606 shows test results for Unit No. 182; points supplied by the manufacturer and those measured at DRL are shown.



RESPONSE AT 1000 CPS OF KANE ENGINEERING LABORATORIES
LOGARITHMIC VOLTAGE COMPRESSOR MODEL C-7A SERIAL NO.182

DRL-UT
DWG AS 7606
JVK-PRS
2-5-63

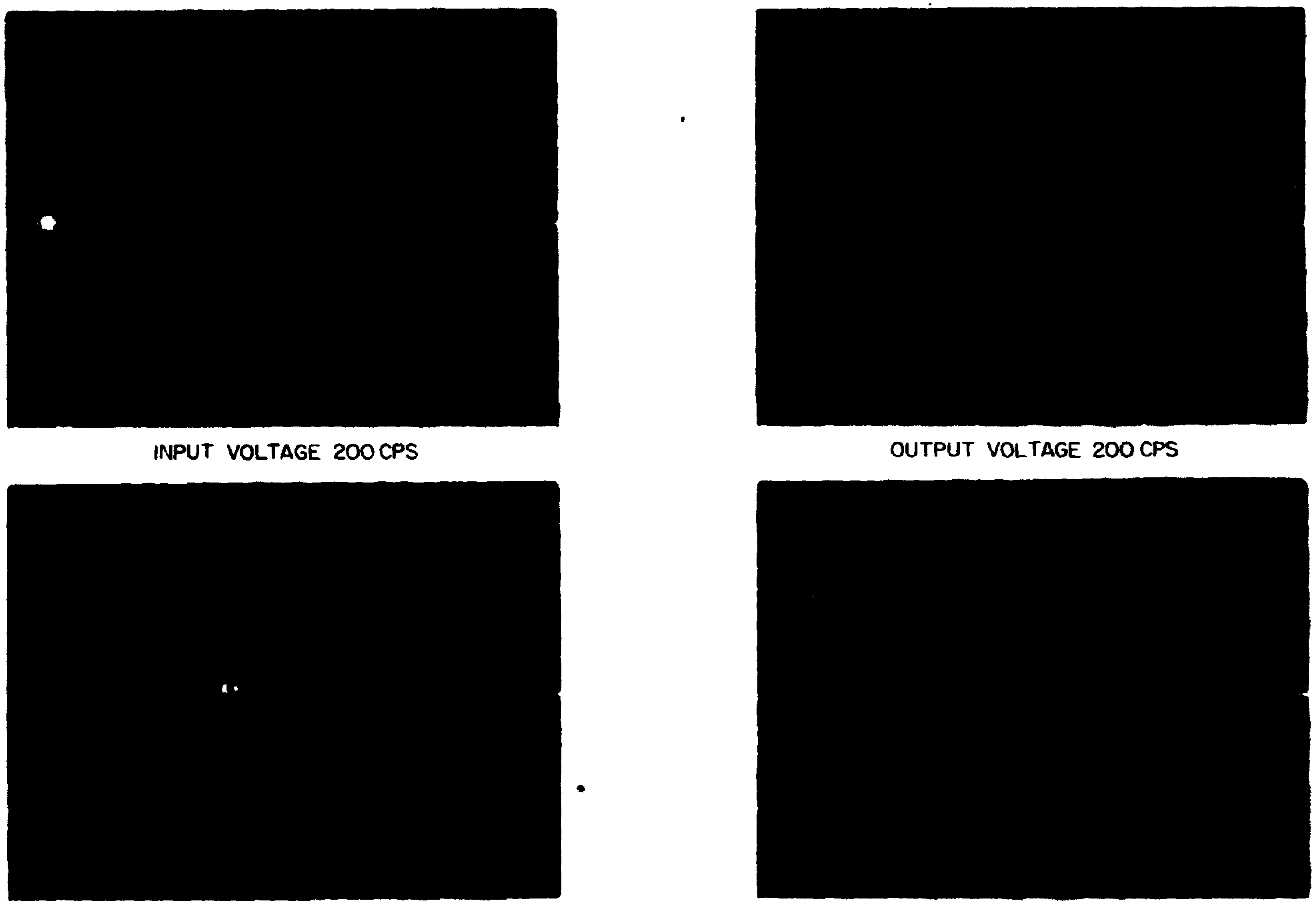
Photograph 88181-1 shows a group of photographs of oscilloscope traces of corresponding input and output voltages for Unit No. 182. Input voltages were supplied by a "ringing" RLC network. Photographs for frequencies of approximately 200 cps and 2000 cps are shown. It can be seen that the output voltage envelope is almost straight for the exponential decay of input voltage amplitude.

The impedance computer application requires an oscillator that has a logarithmic shaft rotation versus frequency characteristic over the frequency range of operation of the computer. Inasmuch as the computer under development is expected to be operable in the range 10-2000 cps, the oscillator specified is not suitable without modification. A motor drive unit for the oscillator which will change the frequency shaft angle characteristic as required has been designed and is being built. With the addition of this unit the oscillator will be driven through cams in the interval 0-100 cps and through straight gearing from 100 cps to 2 kc. Cams for the drive unit are shown in Photo. 88181-2. The two linear potentiometers indicated in the block diagram Dwg. AS-7605 are also positioned by the mechanical drive unit.

3. Circuits of Computer Elements

Schematic diagrams of computer elements to be built at DRL are given on Dwgs. AS-7607, AS-7608, and AS-7609 which show respectively the preamplifiers and compensation network, signal amplifier, and phase meter isolator. The component values given are tentative and subject to change after the circuits are checked in "breadboard" tests.

Design of the rectification and addition circuits is not yet complete.



INPUT VOLTAGE 200 CPS

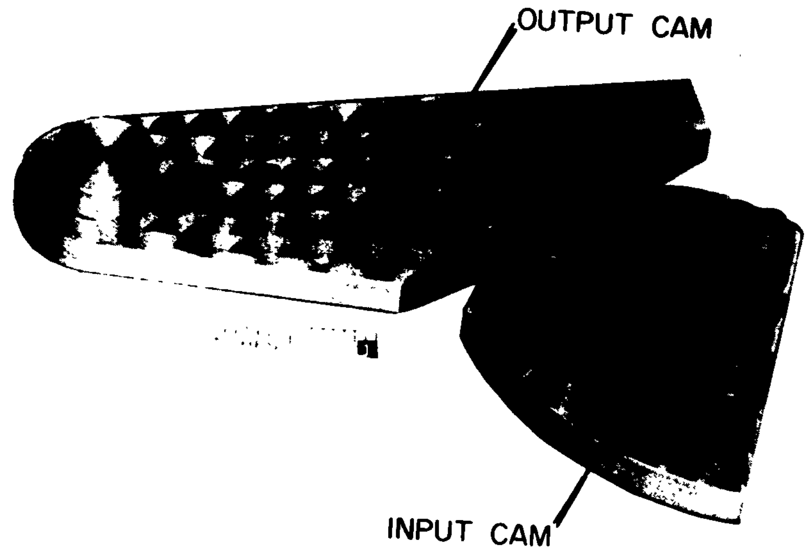
OUTPUT VOLTAGE 200 CPS

INPUT VOLTAGE 2000 CPS

OUTPUT VOLTAGE 2000 CPS

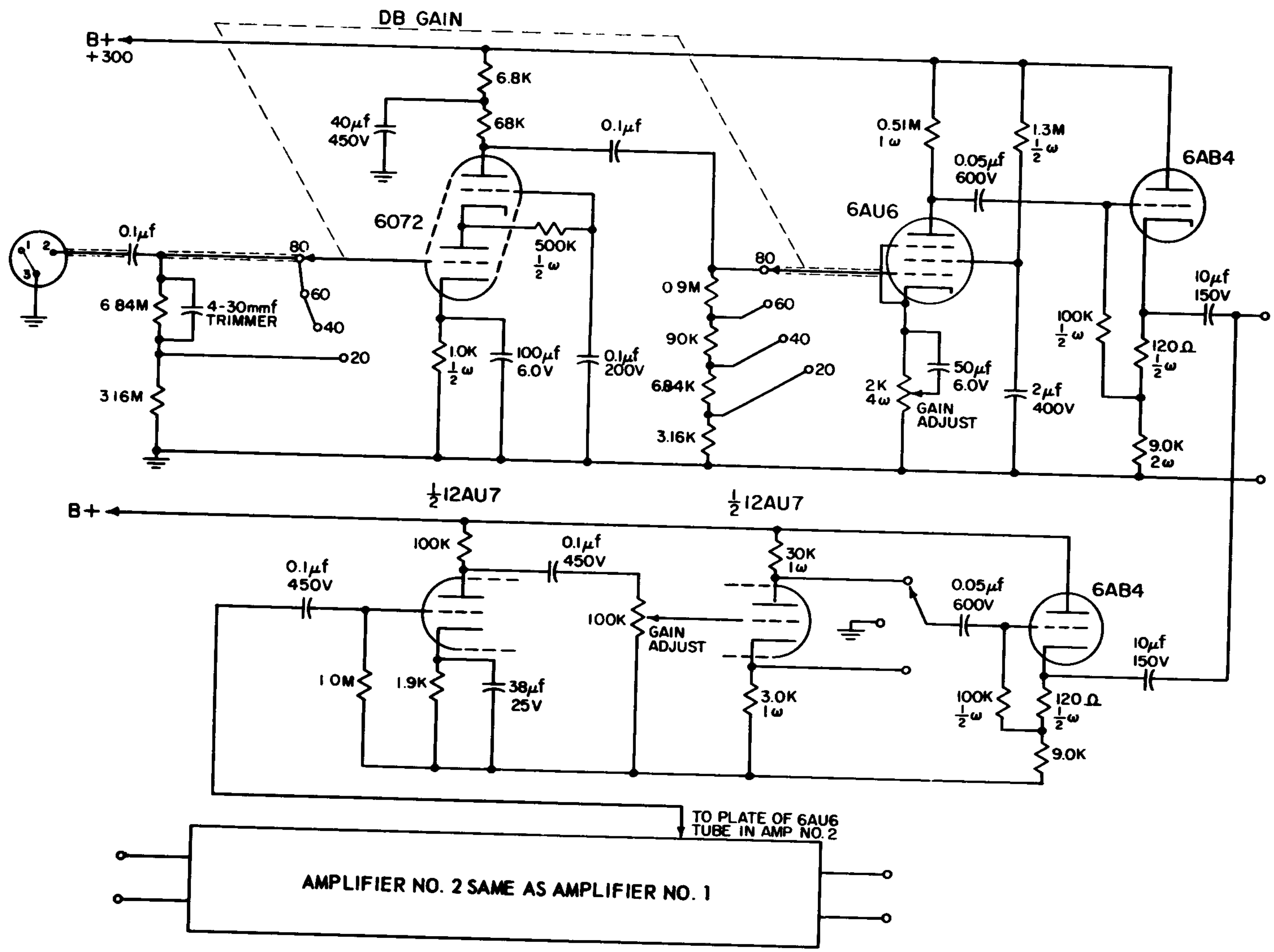
88181-1

PHOTOGRAPHS OF OSCILLOSCOPE TRACES
OF LOGARITHMIC COMPRESSOR VOLTAGES



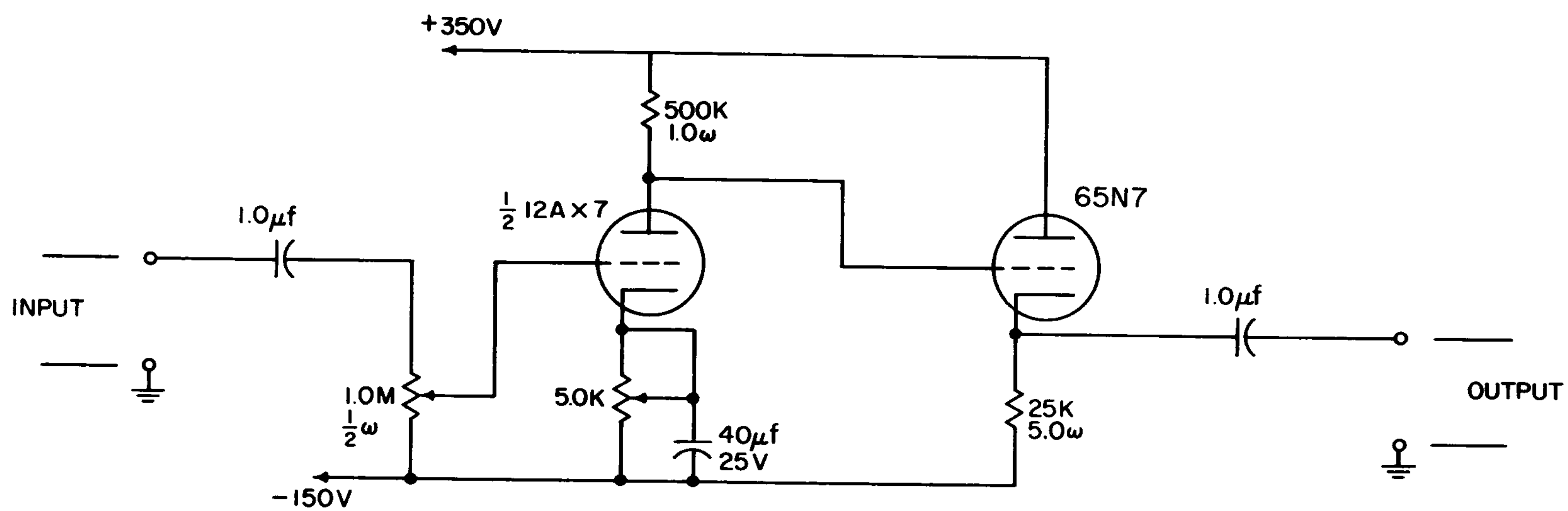
CAMS FOR BFO NONLINEAR MECHANICAL DRIVE UNIT

88181-2



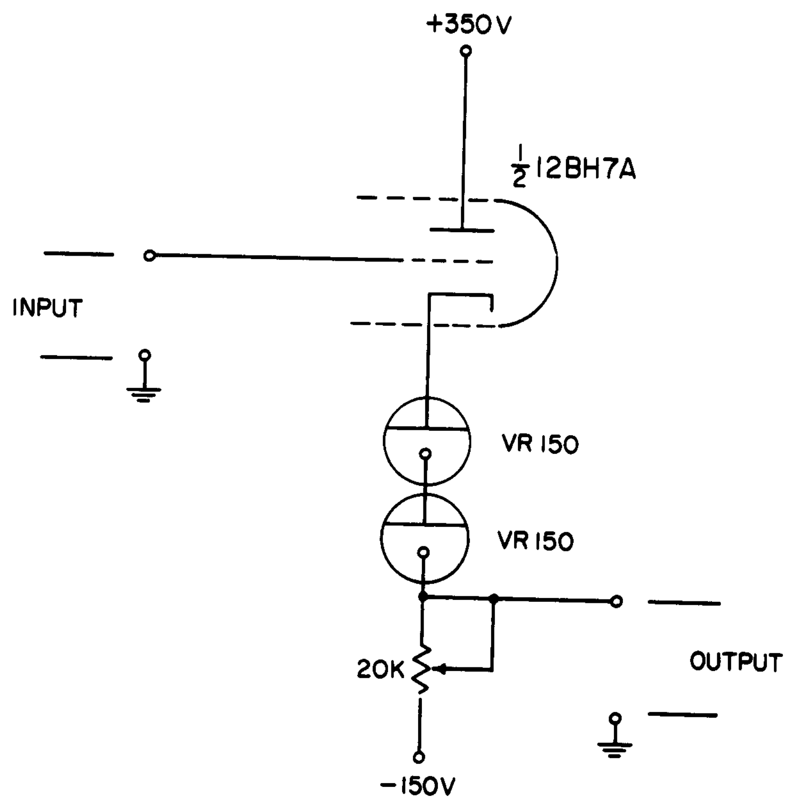
SIGNAL PREAMPS NUMBER 1 AND 2 AND COMPENSATION NETWORK

DRL - UT
DWG AS 7607
JVK - PRS
2 - 15 - 63



SIGNAL AMPLIFIER
(TWO REQUIRED)

DRL - UT
DWG AS 7608
JVK - PRS
2 - 11 - 63



PHASE METER ISOLATOR
(ONE REQUIRED)

DRL - UT
DWG AS 7609
JVK - PRS
2-6-63

C. Filter Calculations with Measured Admittances

For calculation of absolute sound pressures at the input and output ports of an acoustic filter the following information or the corresponding impedance information is needed:

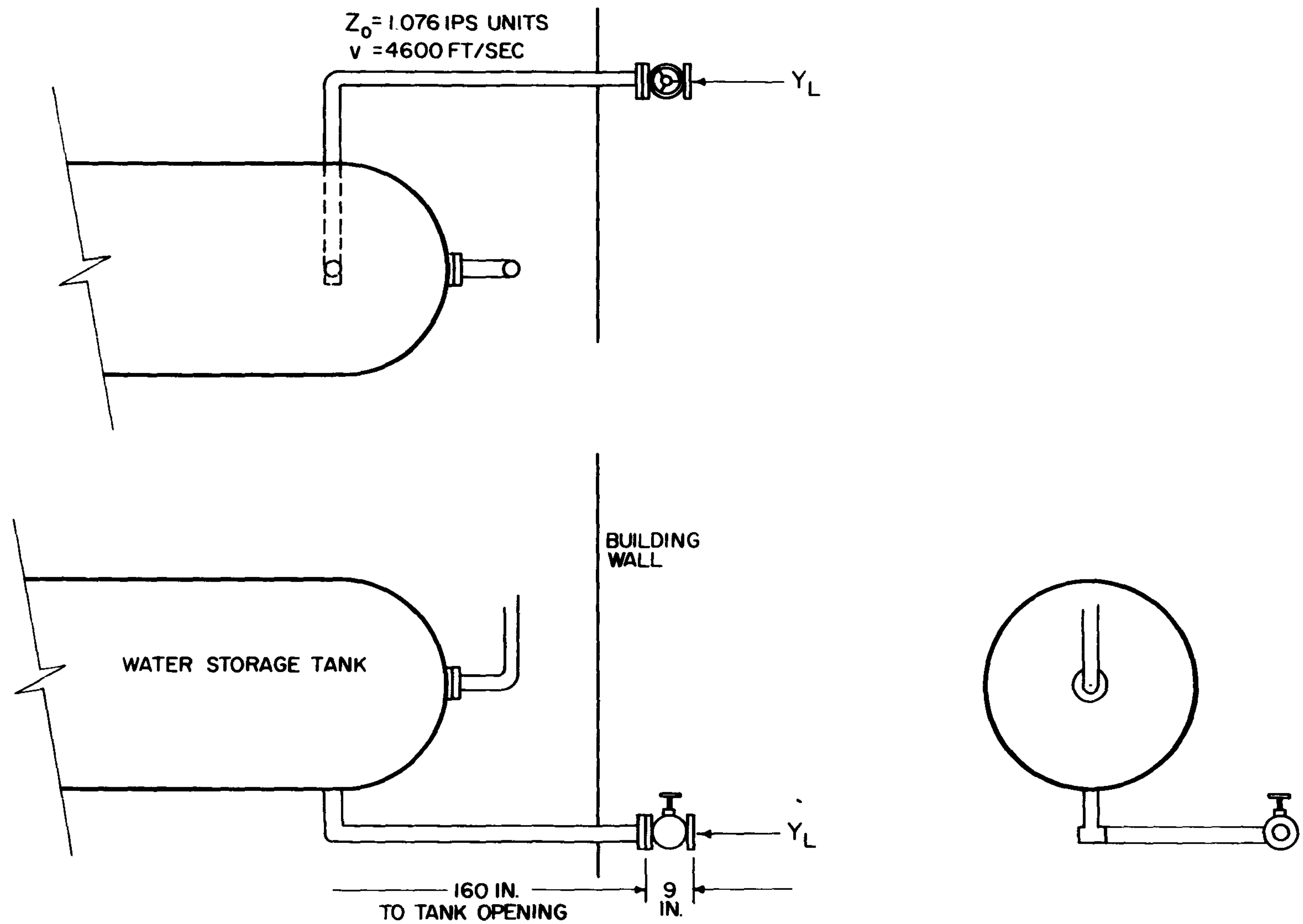
(1) Admittance of the filter load
(2) Specification of the filter in sufficient detail to permit transformation of the load admittance to the filter input port
(3) Internal admittance of the source
(4) The volume velocity source strength

Analytical methods are available for calculating admittances for only a few different classes of loads such as infinite lines, open pipes, flanged openings, etc. Transformation of the load admittance past side branches, and through expansion chambers and other simple types of filters, is a straightforward procedure, but results will be in error if characteristic and branch admittances are not accurately known. Acoustical source characteristics of pumps, a class of sources of great practical interest, are not easily found by either calculation or measurement.

Some of the difficulties listed above can be obviated by direct measurements of admittance. A particular load, filter, and source is being studied in this way. The load comprises a water-filled pipe leading into a large storage tank. Drawing AS-7610 is a sketch showing significant details of the load.

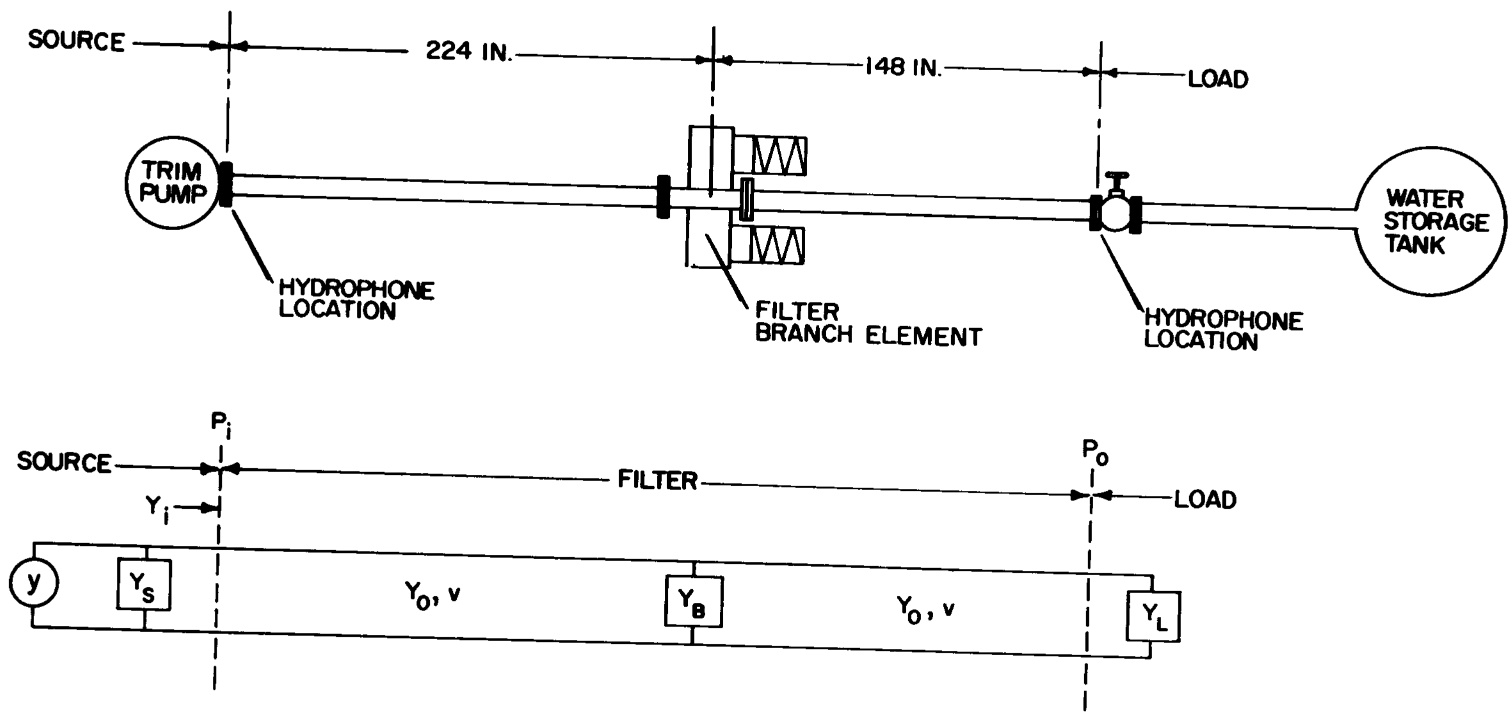
The filter being considered has one spring-piston type branch element preceded and followed by pieces of straight pipe. Drawing AS-7611 shows dimensions of the filter and gives acoustical parameter values for the branch element. The source is the submarine trim pump.

The investigation of this entire combination is to be carried on in the following order. First, the admittance of the spring-piston element will be calculated and measured. Then the load admittance of the pipe and tank will be calculated and measured. Finally, admittance of the trim pump casing will be



PHYSICAL LAYOUT OF FILTER ACOUSTIC LOAD

DRL - UT
DWG AS 7610
JVK - PRS
2 - 12 - 63



Y_L = LOAD ADMITTANCE TO BE MEASURED UNDER NO-FLOW CONDITION

Y_O = CHARACTERISTIC ADMITTANCE $1.32 \frac{IN^5}{LB\ SEC}$

Y_B = BRANCH ADMITTANCE MEASURED (DWGS. AS 7612 AND 7613)

Y_S = SOURCE ADMITTANCE TO BE MEASURED UNDER NO-FLOW CONDITION

V_S = SOURCE VOLUME VELOCITY CORRESPONDING TO UNIT SOURCE SOUND PRESSURE

v = WAVE VELOCITY = 3964 FT/SEC

Y_i = FILTER INPUT ADMITTANCE TO BE CALCULATED

PHYSICAL LAYOUT AND ACOUSTICAL CIRCUIT
REPRESENTATION OF LOAD, FILTER AND SOURCE

DRL – UT
DWG AS 7611
JVK – PRS
2 – 14 – 63

measured at the discharge port with the suction line and pump full of water but not in operation. Admittance at this point will also be calculated by representing the pump casing as an enlarged chamber and the suction pipe as an infinite transmission line. It is unlikely that measurement under no flow conditions will give values of source admittance correct for the operating condition, but values found in this way will be used as first approximations.

Drawing AS-7611 is a sketch of the complete arrangement showing source, filter, and load. The measured values of admittance will be used in calculating the ratio of filter output to input sound pressure and the absolute pressures at the input and output ports for assumed unit source pressure. Output to input pressure will then be measured under flow conditions for comparison.

The calculation procedure to be used is outlined as follows. The filter input admittance Y_i will be found by transforming the load admittance Y_L to the point of attachment of the branch admittance Y_B, adding Y_B, and then transforming the sum to the filter input port. The ratio of output to input sound pressures can then be expressed in terms of Y_L and Y_i.

Assuming the filter can be considered lossless, the average power into the filter equals average power into the load.

$$P_i^2 \, R_e(Y_i) = P_o^2 \, R_e(Y_i) \quad .$$

Here P_i is sound pressure at the filter input and P_o is sound pressure at the output. Therefore the magnitude of the pressure ratio is

$$\frac{|P_o|}{|P_i|} = \left[\frac{R_e(Y_i)}{R_e(Y_L)}\right]^{1/2} \quad .$$

Now admittance Y_i can be regarded as a load applied directly to the source. The source volume velocity V_s corresponding to assumed unit source pressure can be found.

$$V_s = P_s Y_s \quad ;$$

$$V_s \Big|_{P_s = 1} = Y_s \quad .$$

Pressure at the filter input P_i is then

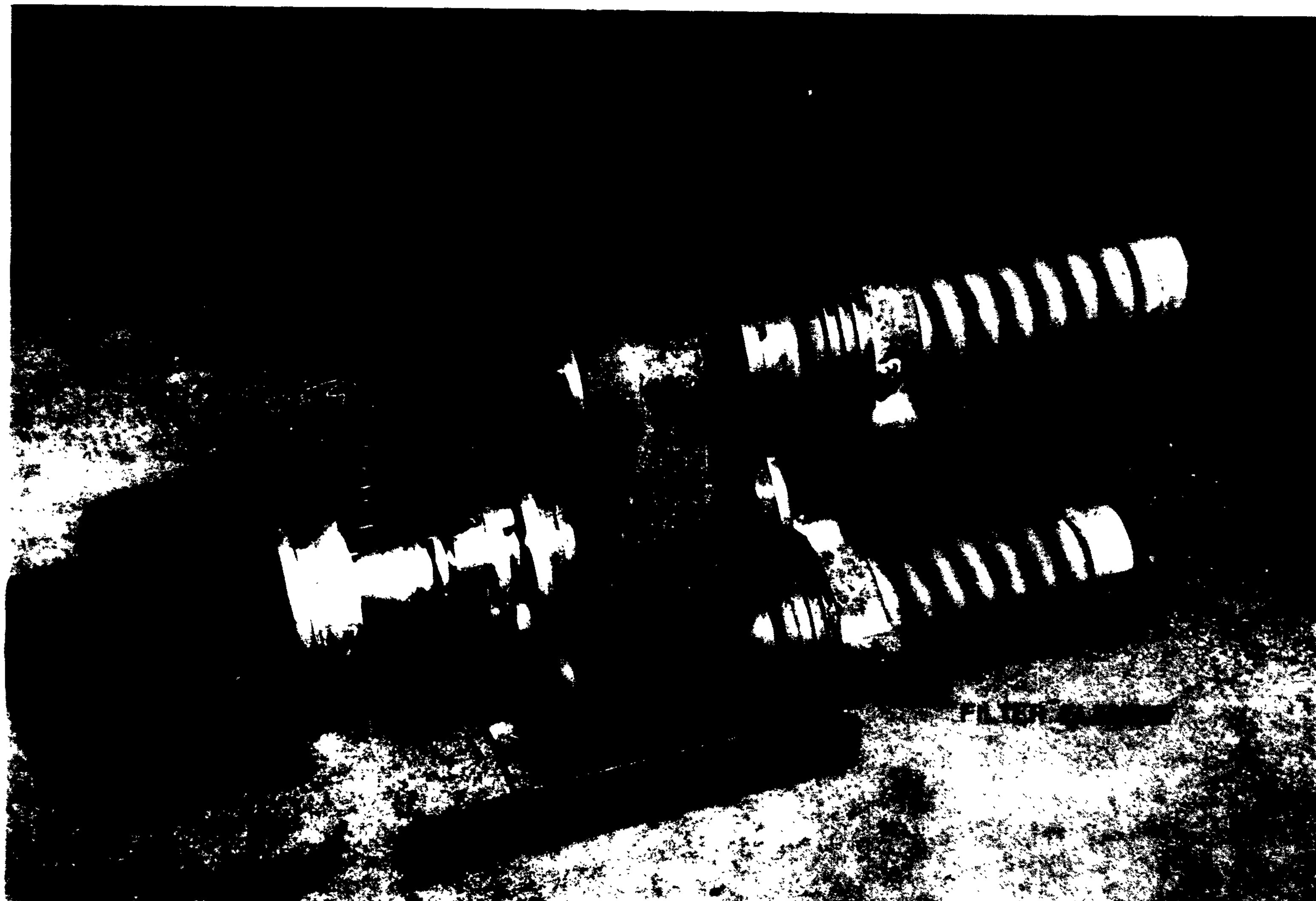
$$P_i \Big|_{P_s = 1} = Y_s \left(\frac{1}{Y_s + Y_i} \right) = \frac{1}{1 + Y_i/Y_s} \quad .$$

The ratio $\frac{|P_o|}{|P_i|}$ has already been found, so $P_o \Big|_{P_s = 1}$ can be obtained.

$$P_o \Big|_{P_s = 1} = \frac{|P_o|}{|P_i|} \; P_i \Big|_{P_s = 1}$$

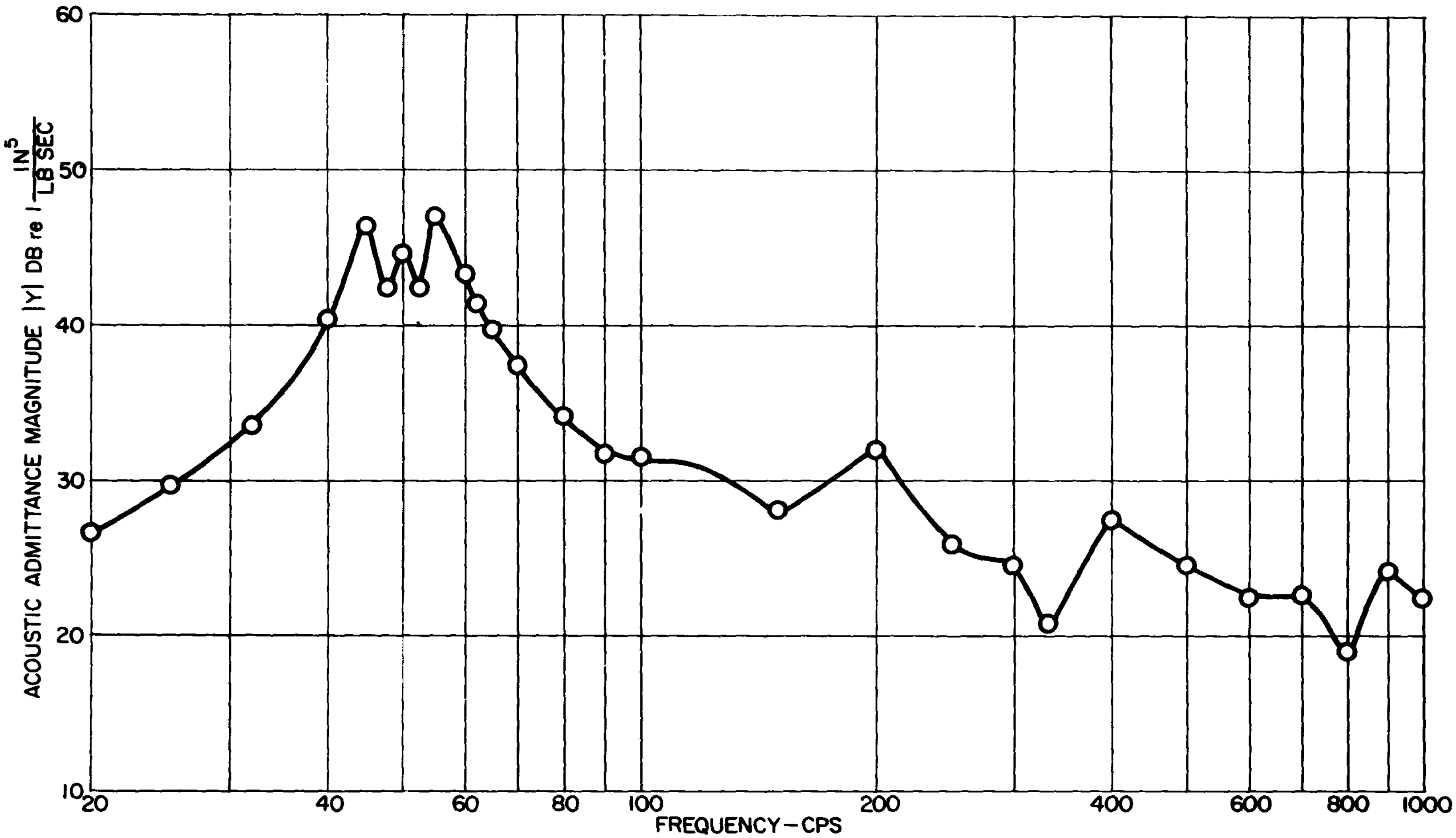
These calculations which would be tedious to perform by hand will be carried out by machine computation in the frequency range 20 cps - 2000 cps. Values of frequency and corresponding measured values of admittance will be read in as data. The required computer program is being written.

Admittance of the filter branch element has already been measured and calculated. Photograph 88181-3 shows the measuring setup with the filter element and impedance head fastened together. Drawings AS-7612 and AS-7613 show, respectively, measured values of admittance magnitude and angle plotted versus frequency. Calculated values of admittance magnitude are plotted on Dwg. AS-7614. The measured values of admittance are larger than calculated values at almost all frequencies. The frequencies at resonance are in fairly good agreement, however. These differences may be due to an abnormally large compliance introduced by irregularities in the bellofram seals at very low pressure.



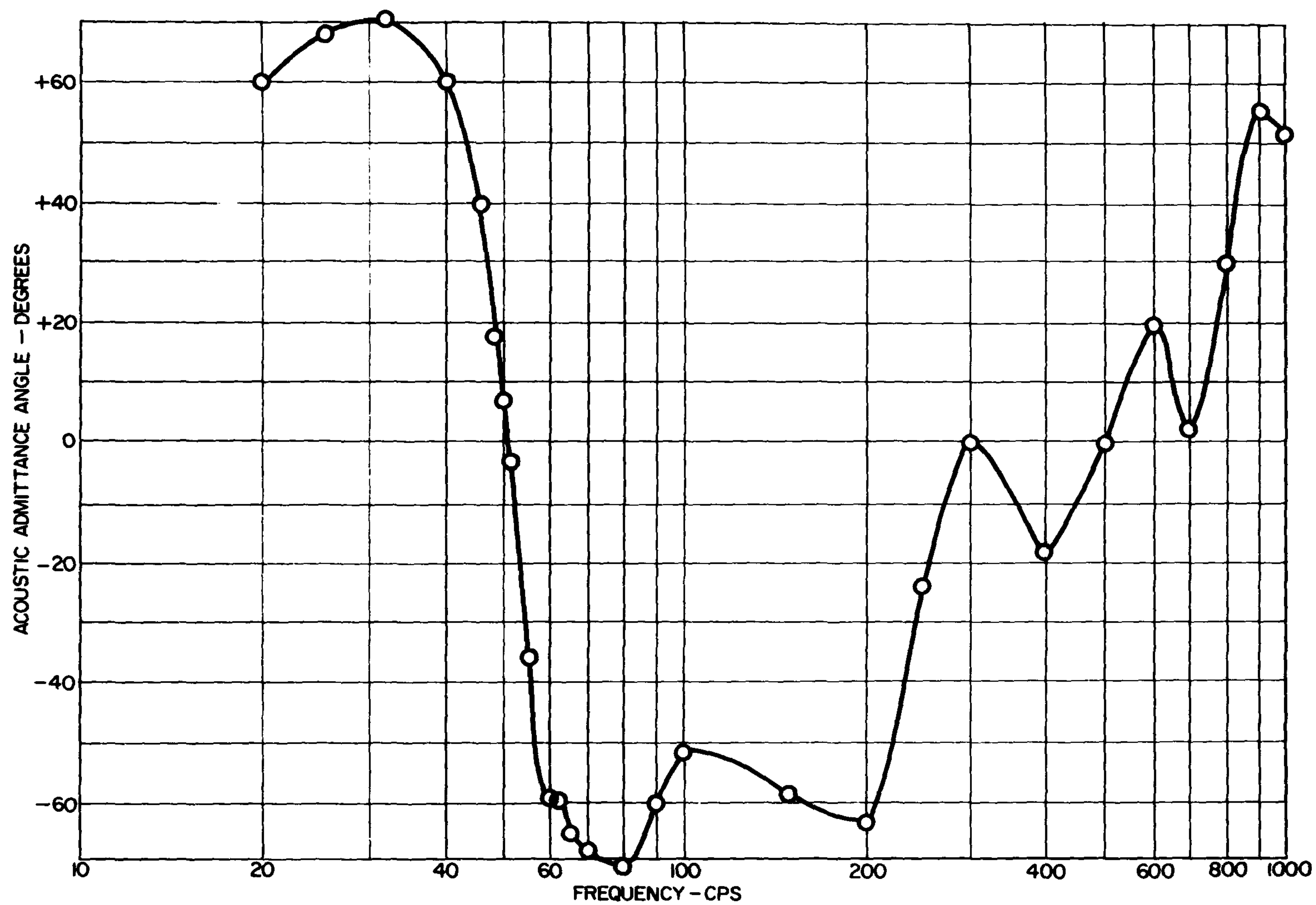
SETUP FOR MEASURING ACOUSTIC ADMITTANCE
OF FILTER SIDE-BRANCH ELEMENT

88181-3



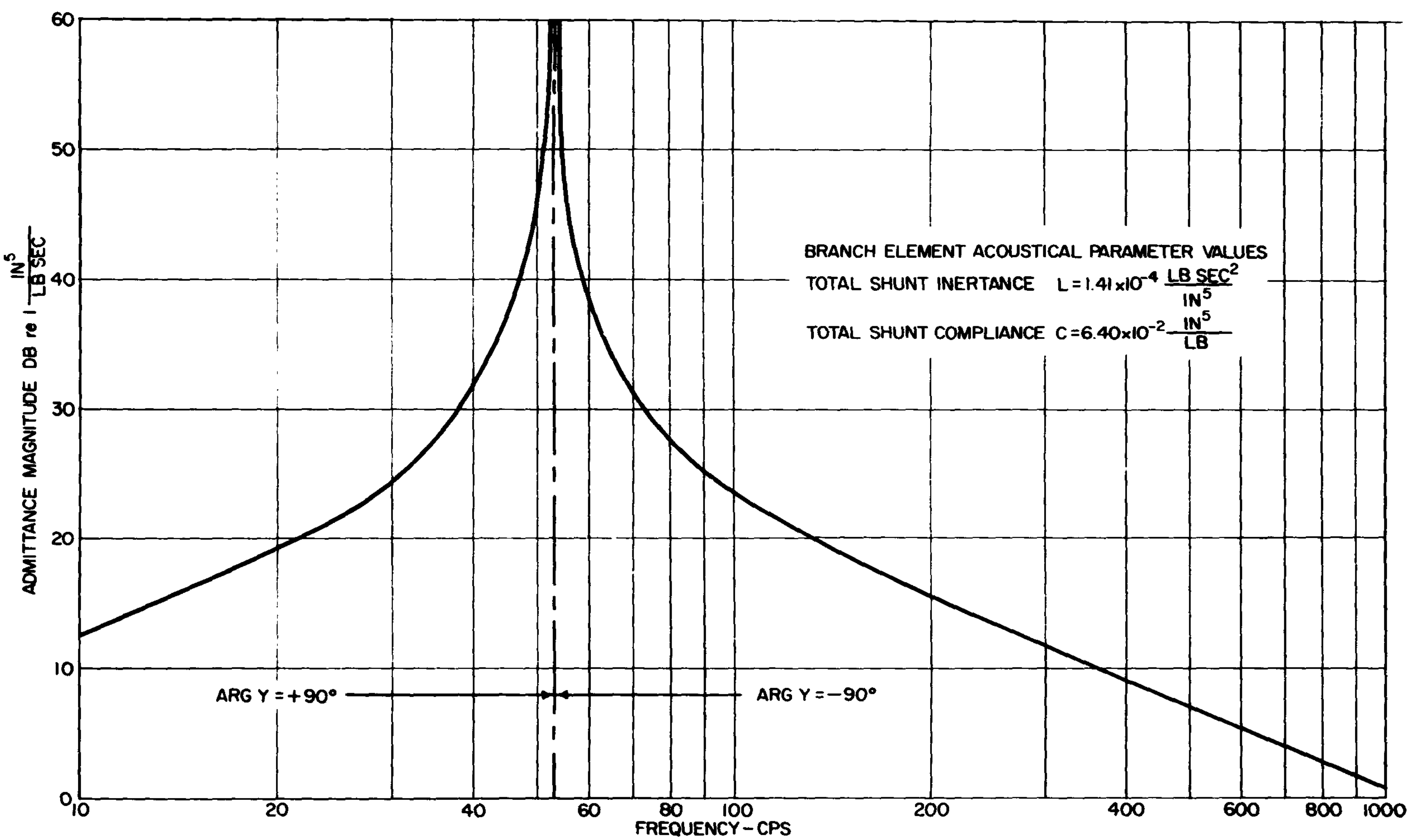
MEASURED VALUES OF ACOUSTIC ADMITTANCE MAGNITUDE PLOTTED VERSUS FREQUENCY FOR SPRING – PISTON FILTER BRANCH ELEMENT

DRL – UT
DWG AS 7612
JVK – PRS
2 – 4 – 63



MEASURED VALVES OF ACOUSTIC ADMITTANCE ANGLE PLOTTED VERSUS FREQUENCY FOR SPRING-PISTON FILTER BRANCH ELEMENT

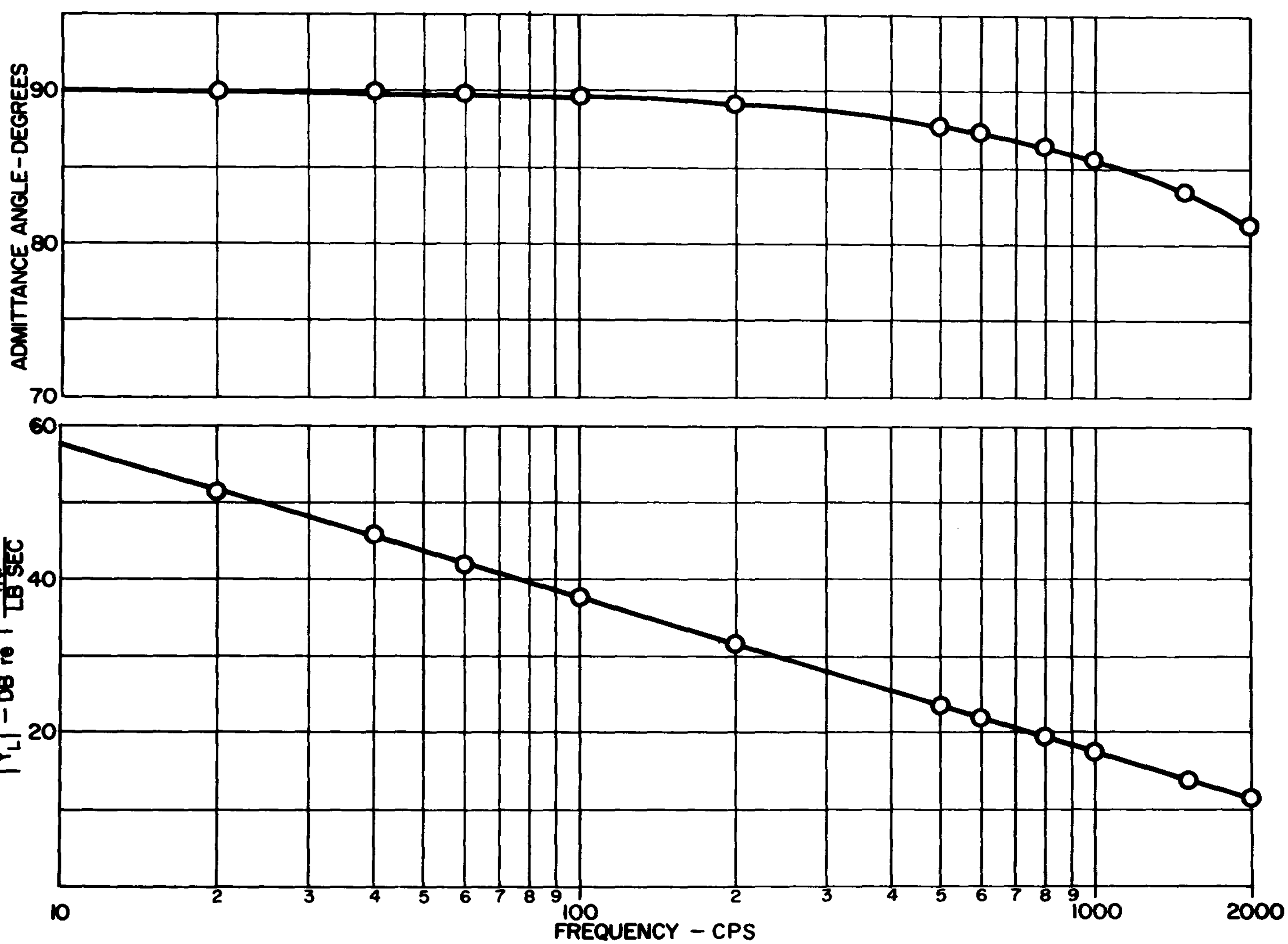
DRL - UT
DWG AS 7613
JVK - PRS
2 - 6 - 63



CALCULATED VALUES OF ACOUSTIC ADMITTANCE
OF SPRING – PISTON FILTER BRANCH ELEMENT

DRL – UT
DWG AS 7614
JVK – PRS
2 – 5 – 63

Admittance-frequency characteristics for the load have been calculated by assuming that the opening to the tank can be represented as a flanged opening in an infinite baffle and that the water column and pipe comprise a uniform transmission line. Admittance magnitude as predicted by these calculations is plotted versus frequency in Dwg. AS-7616. Over the range covered, admittance magnitude changes with a slope of -20 dB per decade; admittance angle increases from -90 degrees at 10 cps to -81.1 degrees at 2000 cps.



CALCULATED LOAD ADMITTANCE MAGNITUDE
AND ANGLE VERSUS FREQUENCY

DRL - UT
DWG AS7616
JVK - PRS
1 - 31 - 63

D. Resistive Acoustic Termination

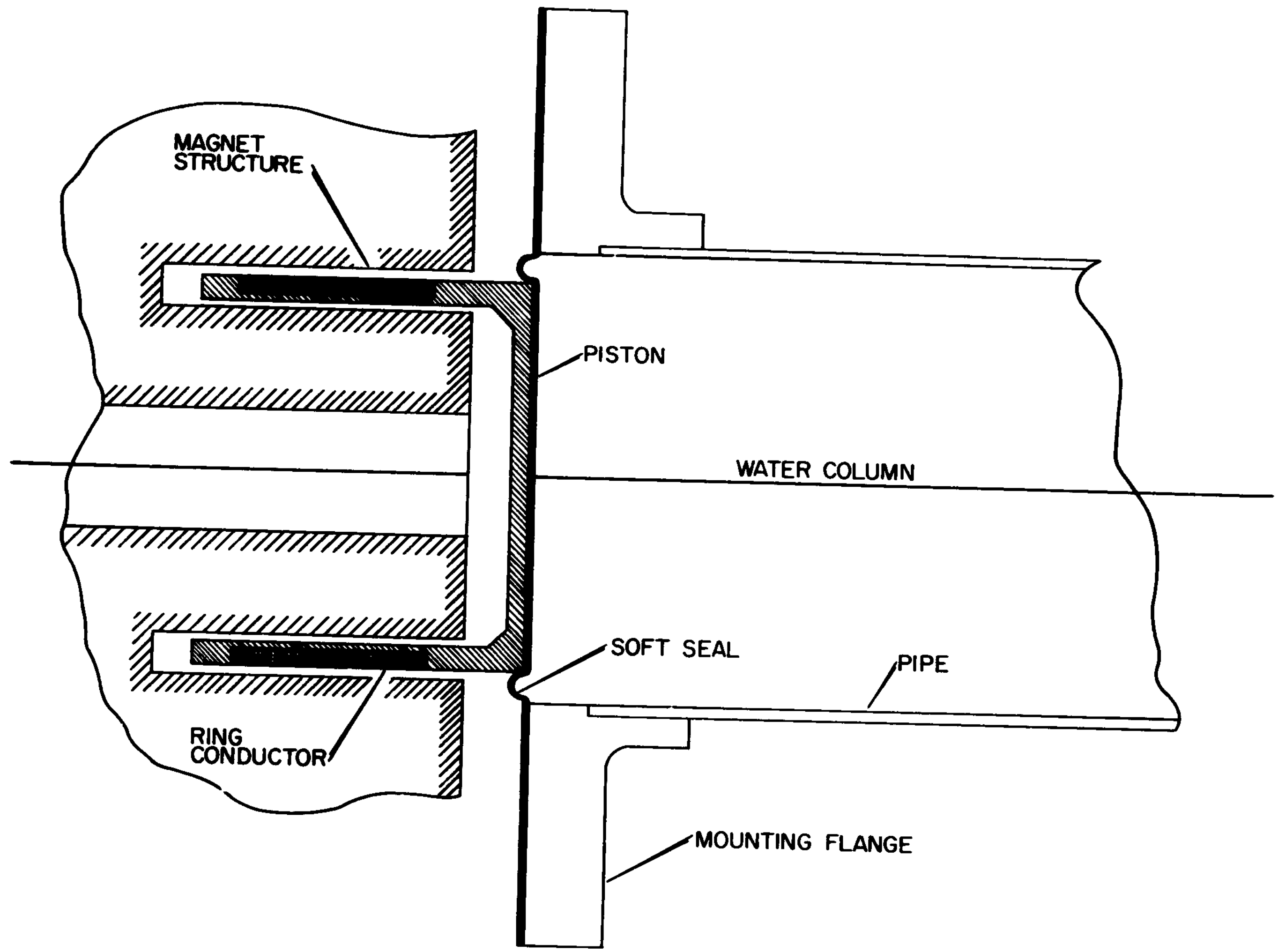
Much of the work at Defense Research Laboratory on acoustic filters and vibration isolating pipe couplings and hangers has been related to units sized for use with 2.875 in. o.d. copper-nickel seamless tubing with 0.072 - 0.083 in. thick wall. Continued use of this material in studies of acoustic impedance of liquid columns during the coming year is foreseen. The characteristic acoustic impedance of a water column confined in this tubing has been found to be 70 dB re 1 gm/sec cm^4, or 3160 $\frac{gm}{sec\ cm^4}$, or 0.75 $\frac{lb\ sec}{in^5}$. A matched, resistive acoustic termination for this line would be very useful in the work anticipated. The feasibility of devising a termination that would be predominantly resistive over at least a portion of the frequency range of interest is being considered.

One possibility which would be attractive from the control standpoint is that of using an electromagnetic damping device coupled to the water column through a piston. Such an arrangement is shown in Dwg. AS-7617. Measurements and calculations have been made to determine the suitability of the field structure of a small magnetic shaker already on hand for this application. The magnetic flux density B in the air gap has been found for a field current of 500 mA by measuring the force-armature current characteristic with a known length (1776 cm) of wire on the armature coil inside the gap. The curve obtained is shown in Dwg. AS-7618. Slope of this curve is 1.8 kg per ampere or 1.765×10^6 dynes per ampere. This value along with the governing equation,

$$F \text{ dynes} = (B \text{ gauss})\ (\ell \text{ cm}) \left(\frac{I}{10} \text{ amperes} \right) \quad ,$$

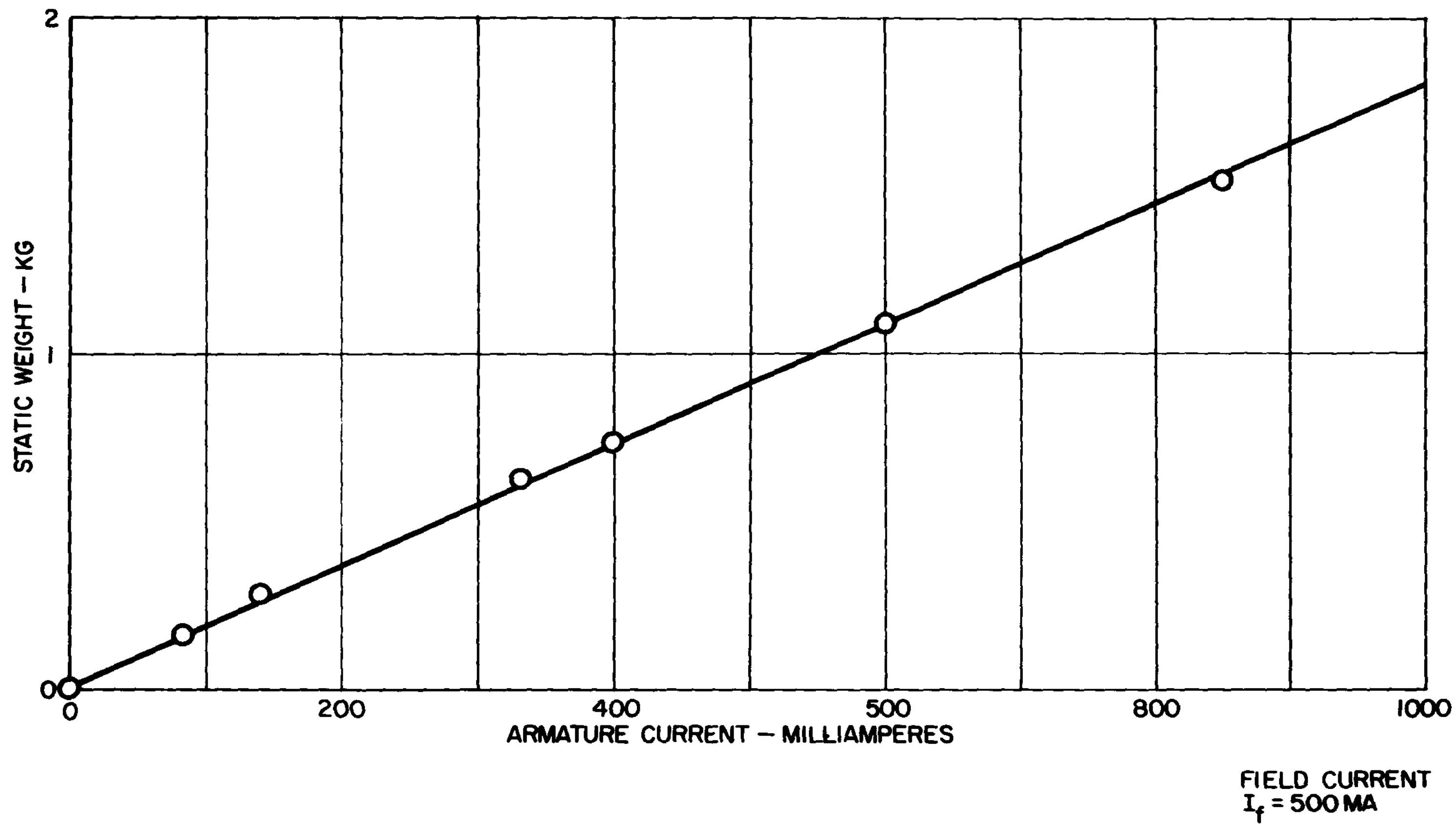
implies that B was of the order of 10^4 gauss. The emf induced in a conductor moving in a magnetic field in a direction perpendicular to the field is given by the equation,

$$e \text{ volts} = (B \text{ gauss})\ (\ell \text{ cm})\ \left(v \frac{cm}{sec}\right)\ (10^{-8}) \quad ,$$



ELECTROMAGNETIC DAMPING DEVICE

DRL - UT
DWG AS7617
JVK - PRS
1 - 29 - 63



STATIC WEIGHT LIFTED BY MB VIBRATION
EXCITER VERSUS DC ARMATURE CURRENT

DRL – UT
DWG AS 7618
JVK – PRS
2 – 1 – 63

where B is flux density, ℓ is the length of conductor perpendicular to the direction of the field, and v is speed in centimeters per second. The length of a single-turn conductor in the air gap of the shaker magnet structure is 18.8 cm. This value is based on the mean radius of the gap. The product $B\ell$ then is 1.88×10^5 gauss cm. The two governing equations can be combined to give

$$\frac{F}{V} = \frac{(B\ell)^2}{10^9}\frac{I}{E} \quad .$$

This equation relates the electrical admittance, $Y_e = \frac{I}{E}$, of the conductor to the mechanical impedance, $Z_m = \frac{F}{V}$, attributable to the magnetic force on the conductor,

$$Z_m = \frac{(B\ell)^2}{10^9} Y_e \quad .$$

Thus for a given value of $B\ell$ the mechanical impedance is controlled by the coil electrical resistance, $R = \frac{1}{Y_e}$.

The mechanical impedance desired is that corresponding to an acoustic impedance of $3160 \frac{gm}{sec\ cm^4}$ and a cross section area equal to that of the tubing, $37.5\ cm^2$.

$$Z_m = 4.5 \times 10^6 \frac{gm}{sec} = 4.5 \times 10^6 \frac{dyne\ sec}{cm} \quad .$$

Substituting this value of Z_m into the equation,

$$Z_m Z_e = \frac{(B\ell)^2}{10^9} = (3.54 \times 10^1) \quad ,$$

and solving for Z_e, which equals the electrical resistance, gives

$$Z_e = R_e = 7.9 \times 10^{-6} \text{ ohms} \quad .$$

The lowest value of room temperature resistance obtainable with a ring shaped copper conductor that will fit into the shaker air gap with adequate clearance was found to be about 8×10^{-5} ohms. This is about an order of magnitude too large to produce the desired acoustic impedance. Therefore the present equipment will not produce the required damping force.

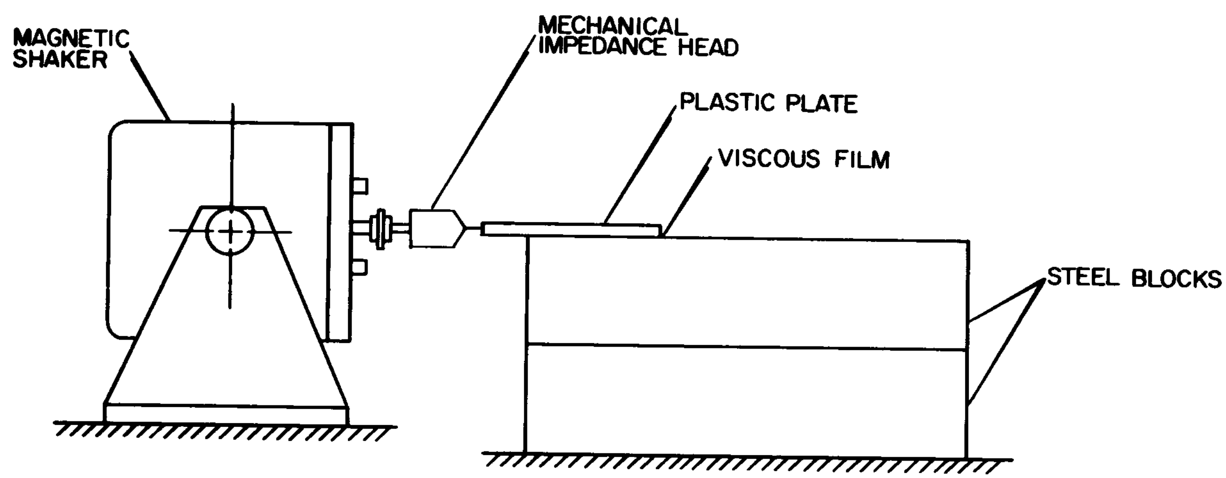
Use of viscous liquids inside tubes or in thin films between solid surfaces to provide the damping for a resistive acoustic termination for water-filled tubing has also been considered.

The mechanical mobilities of films of some different liquids and greases were measured for frequencies below 1000 cps. Drawing AS-7619 is a sketch of the arrangement of equipment used for making these measurements. Films of the various materials tested were placed between a flat plate of acrylic plastic and a large steel block with machine-finished surfaces. The films were approximately 0.020 in. thick. Mechanical mobilities of the plastic plate were measured for forces parallel to the plate surface. Data for the following film materials were taken:

(1) Dow Corning No. 44 Silicone Grease
(2) Dow Corning No. 33 Silicone Grease
(3) Dow Corning Vacuum Grease
(4) Castor Oil

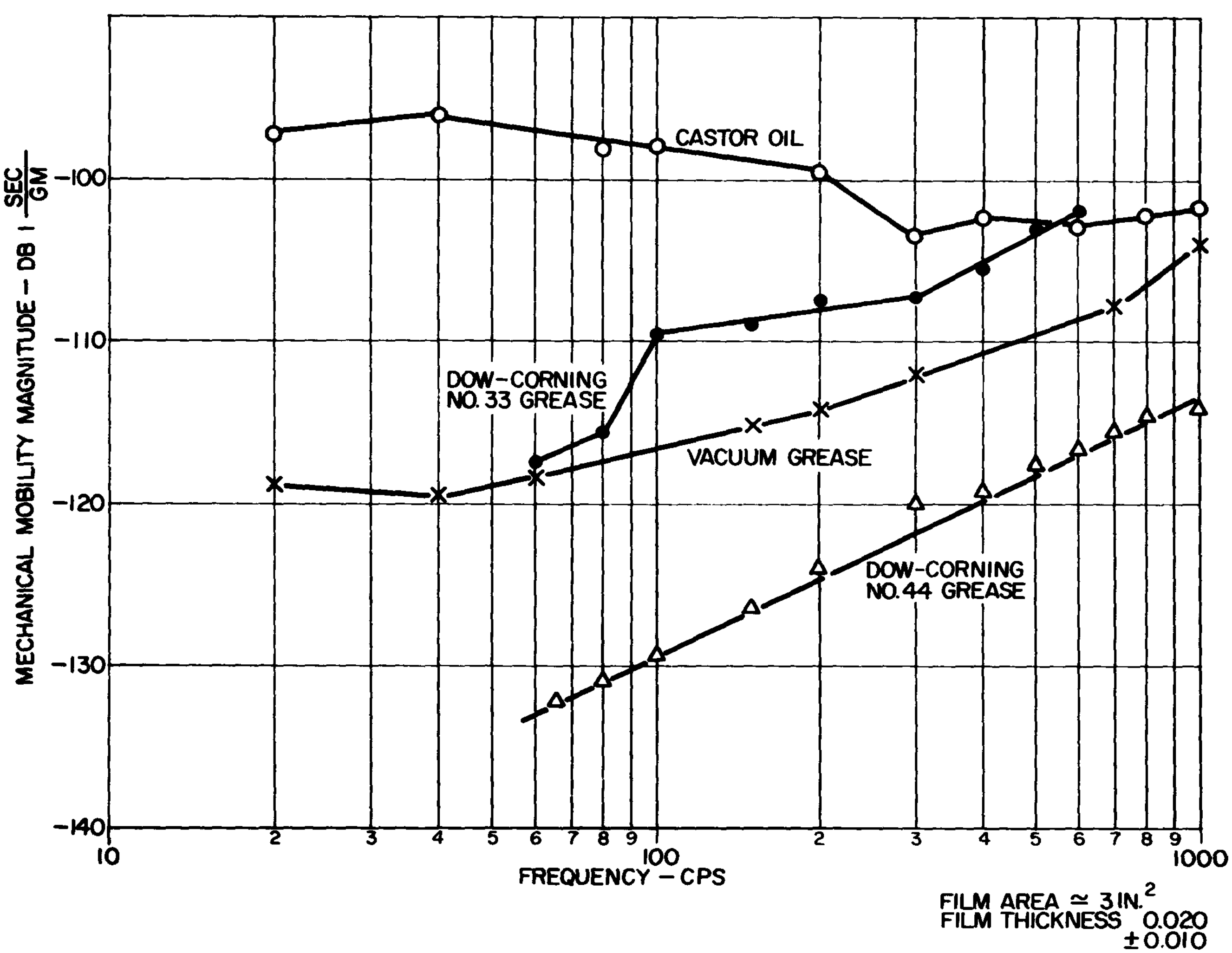
The measured mobility magnitudes are plotted on Dwg. AS-7615. It can be seen that the castor oil film maintained the most nearly constant mobility magnitude over the frequency range of measurement; the mobility changed only 7-1/2 dB between 40 cps and 300 cps. It is believed that it would be difficult to devise a simple arrangement to offer resistive acoustic impedance due to shear forces of viscous films.

The approach to the problem of providing a resistive termination for water columns which appears most promising from the standpoint of simplicity is that of using the resistive effect of liquid flow through holes or other



SETUP FOR MEASURING MECHANICAL MOBILITIES OF VISCOUS FILMS

DRL - UT
DWG AS 7619
JVK - PRS
1 - 28 - 63

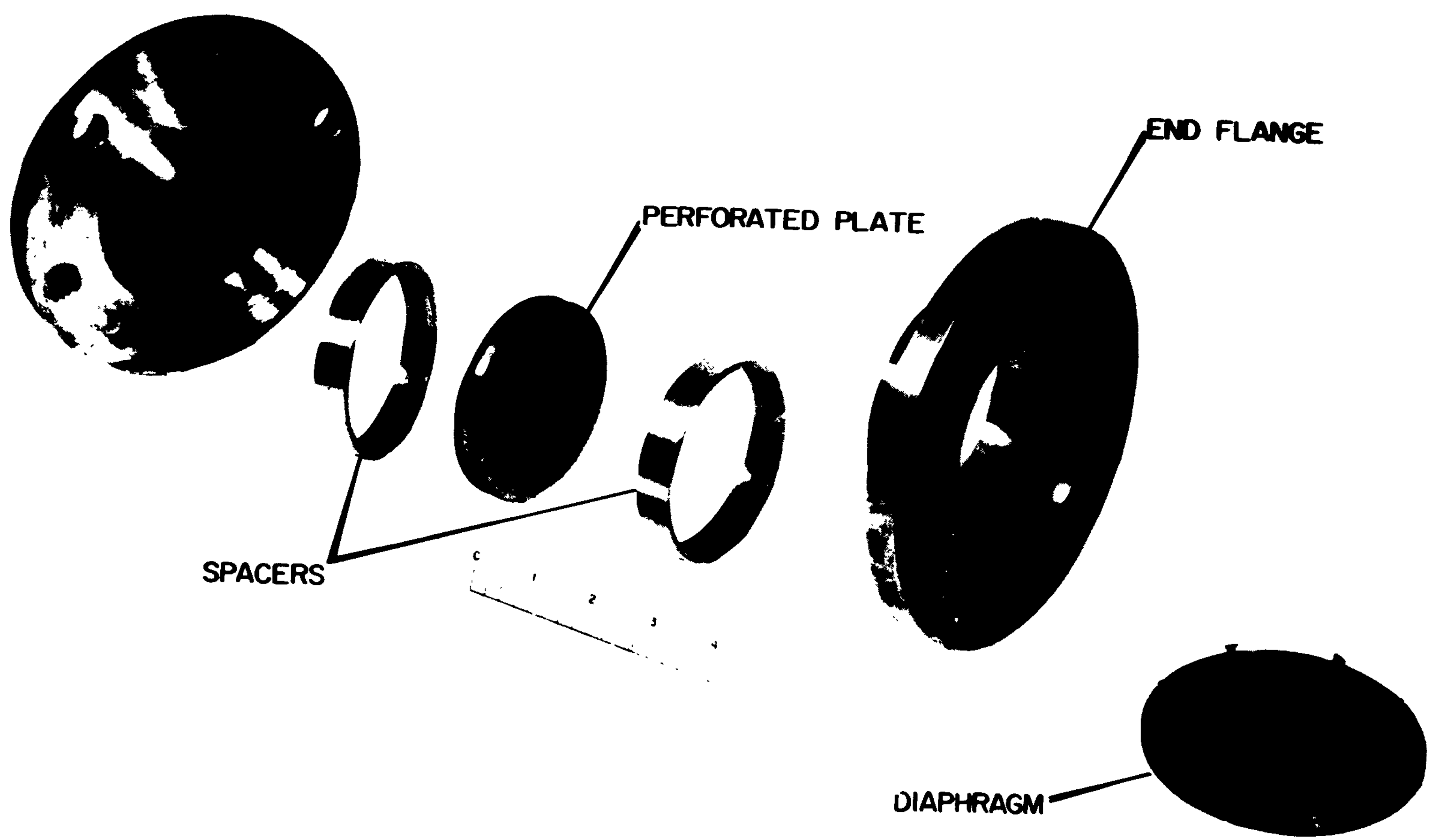


MEASURED VALUES OF MECHANICAL MOBILITY MAGNITUDE FOR FILMS OF VARIOUS MATERIALS

DRL - UT
DWG AS7615
JVK - PRS
2 - 1 - 63

constrictions. Photograph 88181-4 shows parts of an assembly that has been designed to terminate water-filled tubing of the type described. A brass plate 7/16 in. thick, perforated with drilled holes, is mounted inside a cylindrical chamber which can be filled with very viscous silicone fluid and closed by rubber diaphragms at the ends. The chamber structure is fitted with integral, drilled flanges for attachment to mating pipe. The number, diameter, and length of the holes in the perforated plate have been adjusted to offer the desired resistive impedance of $3160 \frac{\text{gm}}{\text{sec cm}^4}$ when 30,000 centistoke viscosity silicone fluid is used. The fluid for filling this unit has been ordered but has not yet been received, so no attempts to determine the actual impedance characteristics of this assembly by measurement have yet been made.

The use of porous metal plates with a fluid of lower viscosity in lieu of the perforated plate is also being considered.



DEVICE TO PROVIDE PREDOMINANTLY
RESISTIVE ACOUSTIC IMPEDANCE

88181-4

DISTRIBUTION LIST

Copy No.	
1 - 3	Chief, Bureau of Ships Department of the Navy Washington 25, D. C. Attn: Code 335
4 - 5 and 1 Reproducible	Chief, Bureau of Ships Department of the Navy Washington 25, D. C. Attn: Code 345
6	Chief, Bureau of Ships Department of the Navy Washington 25, D. C. Attn: Code 434
7	Chief, Bureau of Ships Department of the Navy Washington 25, D. C. Attn: Code 648
8	Chief, Bureau of Ships Department of the Navy Washington 25, D. C. Attn: Code 649
9 - 18	Commander Armed Services Technical Information Agency Attn: TIPDR, Arlington Hall Station Arlington 12, Virginia
19	U. S. Naval Engineering Experiment Station Annapolis, Maryland Attn: Code 824
20	David Taylor Model Basin Carderock, Maryland Attn: Code 564
21	Commander Portsmouth Naval Shipyard Portsmouth, New Hampshire Attn: Code 251
22	Commander Mare Island Naval Shipyard (Rubber Laboratory) Vallejo, California

DISTRIBUTION LIST (Cont'd)

Copy No.	
23	Electric Boat Division General Dynamics Corporation Research and Development Laboratory Groton, Connecticut
24	Newport News Shipbuilding and Drydock Company Engineering and Research Laboratory Newport News, Virginia
25	Chief, Office of Naval Research Washington, D. C. Attn: Code 411
26	Mr. F. M. Lucas Special Representative Office of Naval Research 2506 Main Building The University of Texas Austin 12, Texas
27	Director, DRL/UT
28	C. M. McKinney, DRL/UT
29	E. L. Hixson, DRL/UT
30	J. V. Kahlbau, DRL/UT
31-32	Library, DRL/UT

Defense Research Laboratory, The University of Texas, Austin, Texas. PROGRESS REPORT NO. 1, Contract NObs-88181, by J. V. Kahlbau. January 1963. 40 p. incl. illus. (Contract NObs-88181)

Unclassified Report

Electronic equipment to process and combine electrical signals from transducers in mechanical or acoustical impedance heads in a particular way produces output voltages proportional to impedance or admittance magnitude and the corresponding angle. Design details of such equipment are given. Output/input sound

(over)

UNCLASSIFIED

1. Impedance Acoustical and Mechanical.
2. Admittance, Acoustical.
3. Filters, Acoustic.
4. Resistance, Acoustical.

I. Title
II. Kahlbau, J.V.
III. Contract NObs-88181
IV. Project Serial No. S-F-013-11-01, Task 1359.

Defense Research Laboratory, The University of Texas, Austin, Texas. PROGRESS REPORT NO. 1, Contract NObs-88181, by J. V. Kahlbau. January 1963. 40 p. incl. illus. (Contract NObs-88181)

Unclassified Report

Electronic equipment to process and combine electrical signals from transducers in mechanical or acoustical impedance heads in a particular way produces output voltages proportional to impedance or admittance magnitude and the corresponding angle. Design details of such equipment are given. Output/input sound

(over)

UNCLASSIFIED

1. Impedance Acoustical and Mechanical.
2. Admittance, Acoustical
3. Filters, Acoustic.
4. Resistance, Acoustical.

I. Title
II. Kahlbau, J.V.
III. Contract NObs-88181
IV. Project Serial No. S-F-013-11-01, Task 1359.

pressure magnitude ratio versus frequency for passive acoustic filters can be calculated for unit source pressure from measured values of load, filter branch, and source admittances. Toward devising a resistive acoustic termination of resistance 3160 gm/sec cm^4, three different dissipative effects are considered: (1) Magnetic damping, (2) shear of viscous films and (3) acoustic resistance of multiple, fluid-filled tubes. The tube approach is considered the most promising.

UNCLASSIFIED

pressure magnitude ratio versus frequency for passive acoustic filters can be calculated for unit source pressure from measured values of load, filter branch, and source admittances. Toward devising a resistive acoustic termination of resistance 3160 gm/sec cm^4, three different dissipative effects are considered: (1) Magnetic damping, (2) shear of viscous films and (3) acoustic resistance of multiple, fluid-filled tubes. The tube approach is considered the most promising.

UNCLASSIFIED